

**REMARKS**

With this amendment, claims 1, 2 and 58 have been amended. Claims 64 and 65 have been added. The Applicant has carefully and thoughtfully considered the Office Action and the comments therein. For the reasons given below, it is submitted that this application is in condition for allowance.

**35 U.S.C. § 102 Rejections**

(1) In the Office Action on page 2, claim 58 is rejected under 35 U.S.C. § 102(b) as being anticipated by C.N. Iverson and W.D. Jones, “Rhodium-Catalyzed Activation and Functionalization of the C-C Bond of Biphenylene” (hereinafter “Iverson”). The Applicant respectfully traverses the rejection.

As amended, claim 58 recites, *inter alia*, “wherein the R bridging group is i) an alkylene selected from the group consisting of ethylene and substituted variants thereof, propylene and substituted variants thereof, and butylene and substituted variants thereof; or ii) A-Ar-B, in which Ar is an optionally substituted aryl moiety to which A and B are linked on available adjacent carbon atoms, and A and B each independently represent lower alkylene.” In contrast, the teachings of Iverson are limited to a catalyst system in which **the R group is methylene** (p. 5745). Thus, Iverson fails to teach, or fairly suggest, each and every limitation of claim 58. Accordingly, claim 58 is allowable over Iverson, and the rejection should be withdrawn.

(2) In the Office Action on page 2, claim 58 is rejected under 35 U.S.C. § 102(b) as being anticipated by P. Hofmann et al., “Bis(di-t-butylphosphino)methane complexes of rhodium: homogeneous alkyne hydrosilylation by catalyst-dependent alkyne insertion into Rh-Si or Rh-H

bonds. Molecular structures of the dimmer  $[(\text{dtbpm})\text{RhCl}]_2$  and of the silyl complex  $(\text{dtbpm})\text{Rh}[\text{Si}(\text{OEt})_3](\text{PMe}_3)$ " (hereinafter "Hofmann"). The Applicant respectfully traverses the rejection.

As amended, claim 58 recites, *inter alia*, "wherein the R bridging group is i) an alkylene selected from the group consisting of ethylene and substituted variants thereof, propylene and substituted variants thereof, and butylene and substituted variants thereof; or ii) A-Ar-B, in which Ar is an optionally substituted aryl moiety to which A and B are linked on available adjacent carbon atoms, and A and B each independently represent lower alkylene." In contrast, the teachings of Hofmann are limited to a catalyst system in which **the R group is methylene** (e.g., p. 52). Thus, Hofmann fails to teach, or fairly suggest, each and every limitation of claim 58. Accordingly, claim 58 is allowable over Hofmann, and the rejection should be withdrawn.

### **35 U.S.C. § 103(a) Rejection Based on Fox**

(3) In the Office Action on page 3, claims 60 and 62 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 4,504,684, to Fox et al. (hereinafter "Fox"). The Applicants respectfully traverse.

Claims 60 and 62 are non-obvious over the references cited. For example, (1) the reactions taught in Fox use a polymeric catalyst; (2) the reactions occur under conditions that are incompatible with those of the claimed reaction medium and process; and (3) Fox does not disclose or suggest a motivation to modify the catalyst or the reaction conditions to arrive at the claimed reaction medium and process. Indeed, Fox teaches away from such modifications. Accordingly, the claimed reaction medium and process are not disclosed or suggested by Fox.

Claims 60 and 62 depend from claim 1, which recites “wherein R is a bridging group selected from the group consisting of: an alkylene group; and A-Ar-B, in which Ar is an optionally substituted aryl moiety to which A and B are linked on available adjacent carbon atoms, and A and B each independently represent lower alkylene[.]”

Fox teaches a gas-phase reaction that employs a solid polymeric catalyst bound to a surface. (Col. 1, lines 45-50.) Gas-phase reactants are passed over the catalyst, which catalyzes the reaction. (Col. 2, lines 41-48.) The point of Fox is to provide a material “suited for use as solid catalysts in various vapor phase heterogeneous continuous reactions.” (Abstract.) Fox fails to teach the claimed reaction medium and process for at least the following reasons. **The catalysts taught in Fox are polymeric.** (See, e.g., Col. 3, lines 1-3.) The polymeric nature of the catalyst permits it to attain a molecular weight sufficient to ensure it is in the solid phase. (Col. 1, lines 24-50 (describing previously-available solid, polymeric catalysts over which Fox purports to provide an improvement).) The polymeric catalyst in Fox requires 1,3 or 1,4 substitution if it contains an aromatic ring, so as to facilitate polymerization. (Col. 3, lines 46-47; see also Example 3, Col. 5, lines 47-62.) Also, where the bridging group is an ethenyl moiety, the substitution is required to be trans (Col. 3, line 48). In contrast, the claimed catalysts require that the substituents be on adjacent carbons and do not require a trans substitution pattern. As a result, **the claimed catalysts will tend not to polymerize,** because, for example, steric conditions from the 1,2 substitution pattern would tend to disfavor polymerization. Accordingly, Fox fails to disclose or suggest “a bidentate compound of the general formula (Ia)[,]” as recited in claims 60 and 62 via claim 1.

Furthermore, Fox teaches a gas-phase heterogeneous reaction. (Col. 1, lines 45-50.) Fox states that the “pressure and temperature” of the reaction system “**must** be selected so that the

process is a vapor phase heterogenous reaction.” (Col. 2, lines 49-51 (emphasis added).) The Fox process it purported to solve the problem of loss of catalyst that occurs during liquid-phase reactions. (Col. 1, lines 14-23, 45-50.) In contrast, the claimed reaction medium and process require a solvent and take place in the liquid phase. (See, e.g., p. 41 of specification as filed.) Thus, the purpose of the processes taught by Fox is to move away from the liquid-phase reaction that the present invention employs. Accordingly, a person of skill in the art would not modify the teachings of Fox to arrive at the claimed processes by using a liquid phase reaction.

In addition, the Fox catalysts are non-chelating. See, e.g., Col. 3, lines 16-28. In contrast, the catalyst systems of the claimed processes permit chelation, as a result of the interatomic distances and flexibility around a metal atom located in proximity to the sites of, e.g., 1,2 substitution on the Ar ring. This demonstrates that the Fox ligands work by a different mechanism than the catalyst system employed in the claimed processes, and a person of skill in the art would not be motivated to modify the teachings of Fox to arrive at the claimed processes.

Therefore, claims 60 and 62 are nonobvious over Fox, because the claimed reaction medium and process are not disclosed or suggested by Fox and one would not be motivated to modify Fox in a way to arrive at the present invention. Accordingly, claims 60 and 62 are allowable over Fox. Applicants respectfully request that this rejection be withdrawn.

### 35 U.S.C. § 103 Rejection Based on Fox in view of X.L. Wang

(4) In the Office Action on pages 4-6, claims 1-47, 51-55, 61 and 63 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Fox in view of U.S. Pat. No. 6,348,621, to X.L. Wang et al. (hereinafter “X.L. Wang”). The Applicants respectfully traverse.

Claims 1-47, 51-55 61, 63 and 64-65 are non-obvious over the references cited. For example, a person of ordinary skill in the art would not combine the cited references because they employ incompatible reaction conditions. Indeed, Fox teaches away from the combination suggested in the Office Action. Moreover, the combination fails to disclose or suggest every element of the claims. Accordingly, the claims are patentable over any reasonable combination of Fox and X.L. Wang.

Independent claim 1 recites “A process for the hydroformylation of ethylenically unsaturated compounds, which process comprises reacting said ethylenically unsaturated compound with carbon monoxide and hydrogen, in the presence of a catalyst system, the catalyst system obtainable by combining: a) a Group VIII metal compound; and b) a bidentate compound of general formula (Ia) . . . wherein: R is a bridging group selected from the group consisting of: an alkylene group; and A-Ar-B, in which Ar is an optionally substituted aryl moiety to which A and B are linked on available adjacent carbon atoms, and A and B each independently represent lower alkylene; R<sup>1</sup> to R<sup>12</sup> each independently represent lower alkyl, aryl or Het; Q<sup>1</sup> and Q<sup>2</sup> each independently represent phosphorus, arsenic or antimony, the process characterised in that a chlorine moiety is present in at least said Group VIII metal compound.” Independent claim 2 is similar to claim 1 in aspects relevant here.

Fox is discussed above (see pages 19-20). As noted there, Fox teaches a gas-phase reaction employing a polymeric heterogeneous catalyst (Col. 1, lines 45-50), for the purpose of avoiding the loss of catalyst that occurs during liquid-phase reactions (Col. 1, lines 14-23, 45-50). And the ligands taught in Fox are non-chelating (Col. 3, lines 16-28). In contrast, the claimed processes occur in the liquid phase, and the recited bidentate compound will tend not to polymerize due to, for

example, the substitution pattern on the Ar ring and/or the length of the alkylene substituent (see also new claims 64 and 65). And furthermore, the catalyst system employed in the claimed processes will permit chelation. Accordingly, Fox is incompatible with the claimed processes. Furthermore, Fox leads a person away from modifying the teachings of Fox as suggested in the Office Action to arrive at the claimed processes.

X.L. Wang fails to cure the defects in Fox. X.L. Wang discloses a process for the carbonylation of ethylene using a catalyst system comprising a generic bidentate phosphine. Abstract. However, X.L. Wang does not disclose or suggest the claimed processes for at least the following reasons. First, X.L. Wang's process produces only the corresponding carboxylic acid or ester (Col. 4, lines 6-10). X.L. Wang does not disclose or suggest any utility in producing aldehydes, as in the claimed hyrdoformylation processes. In fact, X.L. Wang teaches that the carbonylation reaction can work in the presence of hydrogen and carbon monoxide (see Col. 3, lines 15-18), the starting materials in the claimed processes used for hydroformylation. This suggests that there is no expectation that the catalyst and process described in Wang could achieve hydroformylation as required by the present claims. Second, X.L. Wang only discloses effectiveness on ethylene (see Col. 1, lines 41-45), not on ethylenically-unsaturated compounds generally, as in the claimed processes. Thus, the combination of Fox and X.L. Wang does not include every element as claimed. Accordingly, the combination of Fox and X. L. Wang does not disclose or suggest the claimed processes.

In any event, a person of skill in the art would not combine X.L. Wang with Fox in the manner described in the Office Action. As noted above, the Fox reaction is heterogeneous, with reactant in the gas phase and a solid support and polymeric catalyst (Col. 1, lines 45-50, 55), for the

purpose of for the purpose of avoiding the loss of catalyst that occurs during liquid-phase reactions (Col. 1, lines 14-23). In contrast, the reactions taught in X.L. Wang take place in the liquid phase. (Col. 3, lines 49-51). In view of Fox's intended purpose, a person of skill in the art would not combine the teachings of Fox and X.L. Wang because doing so would render Fox unsatisfactory for its intended purpose (MPEP 2143.01.V) and undermine the purported benefit taught by Fox.

In addition, the 1,2 substituted Ar compounds in X.L. Wang would tend not to polymerize, which would render them unsuitable for the polymeric catalyst system and processes taught in Fox. In addition, the Fox ligands are non-chelating, whereas the ligands taught in X.L. Wang permit chelation.

For at least the reasons set forth above, the Office Action fails to set forth a *prima facie* case of obviousness. Therefore, claims 1 and 2 are nonobvious over any reasonable combination of Fox and X.L. Wang, and claims 1 and 2 are allowable over Fox and X.L. Wang. Claims 4-47, 51-55, 61, 63 and 64-65 are dependent from claim 1 and are allowable as being dependent from an allowable claim. Similarly, claim 3 depends from claim 2 and is allowable as being dependent from an allowable claim. Therefore, the rejections should be withdrawn.

### CONCLUSION

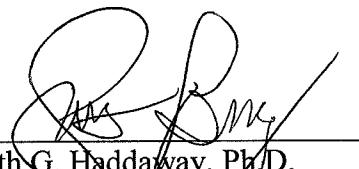
All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any

reason, that personal communication will expedite prosecution of this application, the Examiner is hereby invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment is respectfully requested.

Respectfully submitted,

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